



## Improving Water Use Efficiency in Punjab Agriculture: The Case of Tensiometers

### Background

Intensive agricultural practices in Punjab have resulted into severe over-exploitation of natural resources, especially groundwater. This has mainly occurred due to increase in cropping and gradual dominance of paddy in the production pattern during kharif (summer) season, which has caused severe imbalances in demand and supply of water in Punjab agriculture. The current water requirements of 4.45 million hectare meter exceed the sustainable supply levels of 3.04 million hectare meter by almost 46 per cent. The demand-supply gap has caused faster decline in water tables at the rate of about 75 cm per annum during the last decade, while the earlier decline was much lower at 18 cm per annum during 1982-97 and 42 cm per annum during 1997-2002. Declining water table promoted frequent deepening of borewells and subsequent replacement of the centrifugal pumps by more expensive submersible pumps. The power consumption in Punjab agriculture has more than doubled since 1990-91 and power subsidy has touched high levels of about Rs. 6,000 crore during the last year.

All these trends point towards unsustainable use of groundwater resources, power consumption and subsidies

in Punjab agriculture which needs to be addressed seriously. Multiple strategies such as crop diversification and use of water saving technologies have been envisaged for achieving long-term sustainability of groundwater use in Punjab. The Centers for International Projects Trust (CIPT) in collaboration with Punjab Agricultural University (PAU) is promoting the use of tensiometers in paddy amongst the farmers of Punjab since 2009. Tensiometer is used in paddy for scheduling irrigation and has the potential to save significant amount of water as well as energy in agriculture.

### About the tensiometer

A tensiometer is a simple device designed to measure soil moisture or water potential, i.e. the energy plants need to exert to pull in water from the soil at the current moisture condition. It consists of a porous ceramic cup, connected through a rigid, body tube to a vacuum chamber and all the components are filled with water. The body tube is transparent so that water within the tensiometer can easily be seen. The tensiometer is placed in the field with the ceramic cup in the soil in the plant root zone. The ceramic cup is porous so that water can move through it to equilibrate with the soil water. A partial vacuum is created as water moves from the sealed tensiometer tube. The

pressure associated with this vacuum is a measure of the energy that would need to be exerted by the plant to extract water from the soil. It can be recorded by a gauge, or the critical values for a particular plant can be marked on the tube. The idea behind the use of tensiometer is that if the indicated soil moisture is below what the plant optimally needs to grow, there is a need to apply irrigation water, otherwise not. Such irrigation scheduling can reduce water use in a crop because farmer generally over irrigates the crop irrespective of its requirement especially when water and power to pump out water is free of cost.

A simplified version of the tensiometer was developed by PAU, Ludhiana with a nominal cost of about Rs. 450 per tensiometer. In this tensiometer, the usual gauge has been replaced by the stripes of green, yellow and red colour. While the water level in tensiometer at green level signifies no need for irrigation, there is need to irrigate when the level enters the yellow stripe level. The entry into the red level may adversely affect the crop yield and hence should be avoided.

## Promoting the tensiometers

A comprehensive approach was followed for promoting the use of tensiometers and estimating the extent of water and energy savings. The approach comprised various steps which are outlined below:

- 1. Identification of the operational area:** The tensiometers have been promoted across 9 districts of Punjab, namely, Amritsar, Jalandhar, Kapurthala, Tarn Taran, Moga, Ludhiana, Sangrur, Barnala and Patiala. Till now CIPT and PAU have reached 300-350 villages across these districts.
- 2. Farmers' awareness and trainings:** The farmers have been made aware about the issues of water depletion in Punjab and have been trained effectively on the use of tensiometers.
- 3. Installations:** The tensiometers are installed at the farmers' fields by well-trained field workers.
- 4. Regular monitoring and supervision:** The field workers conduct regular monitoring of the farmers'



**Approach of the interventions**

fields and regularly address the problems in the use of tensiometers. Information on water use, energy, yield and other important parameters is also collected.

- 5. Estimating the water and energy savings:** The water and energy use is compared with the adjoining plots, where farmer irrigates in a traditional manner, not using the tensiometer.

## Reach of tensiometer in Punjab

Till now, CIPT and PAU have reached almost 13,000 farmers for the use of tensiometers towards better irrigation scheduling in Punjab. These farmers have been spread over 350 villages over time. Table 1 indicates the year wise installation figures across the state.

**Table 1: Number of tensiometers installed**

Year	No. of tensiometers installed
2009	525
2010	3,500
2011	1,100
2012	1,500
2013	2,200
2014	4,100*
<b>Total</b>	<b>12,925</b>

**Note:** The figures are provisional as some installations are still in progress.





## Impacts on water and energy saving by the use of tensiometers

The groundwater and energy saving with the use of tensiometers on the fields of adopters are given in Table 2. The use of tensiometers in paddy has resulted into water saving of about 20 per cent and corresponding energy savings of about 24 per cent. At the aggregate level, these water and energy savings turn out to be huge. In addition, there was no adverse impact on the yield of paddy owing to the use of tensiometers.

**Table 2: Impact of tensiometers on water and energy savings**

Particular	Value
Water saving per acre (%)	20
Water saving per acre (litres)	419,062
Energy saving per acre (%)	24
Energy saving per acre (Kwh)	90

## Conclusions

Considering the exploitation of natural resources such as water in agriculture, especially in Punjab, there is dire need to opt for conservation of such resources through available technologies. Water, which is depleting at an alarming rate in the state can be saved through the use of tensiometer by helping the farmers to schedule irrigation in the rice crop.

Tensiometers have a potential to save water in the farmer's field and also the power. There is an urgent need to scale up the use and adoption rate of such technologies keeping in mind the socio-economic profile of the farming community as well as the policy dynamics for agriculture sector in the state.